WHAT IS CLAIMED IS:

1. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit includes a bias power supply unit for outputting a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz.

2. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit includes a bias power supply unit for outputting a bias voltage composed of a negative bias component having a predetermined

negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz, and

a ratio of the predetermined time of the pulse bias to the cycle of the bias voltage is 40% or less.

3. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit includes a bias power supply unit for outputting a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz, and

the pulse output of the pulse bias is a square wave pulse having a pulse width for the predetermined time and a predetermined voltage value.

4. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a

substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit includes a bias power supply unit for outputting a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz, and

a ratio of the predetermined time of the pulse bias to the cycle of the bias voltage is 40% or less, and

the pulse output of the pulse bias is a square wave pulse having a pulse width for the predetermined time and a predetermined voltage value.

5. The ion plating device according to any of Claims 1 to 4, wherein

the bias power supply unit comprises a waveform generator for generating a basic waveform of the bias voltage and a bias power supply for generating the bias voltage having a constant value based on the basic waveform output from the waveform generator.

6. The ion plating device according to any of Claims 1 to 4, wherein

the bias power supply unit comprises a direct current power supply for forming the negative bias and a pulse power supply for forming the pulse bias.

7. The ion plating device according to any of Claims 1 to 4, wherein the bias power supply unit comprises a waveform generator for generating a basic waveform of the bias voltage and a bias power supply for generating the bias voltage having a constant value based on the basic waveform output from the waveform generator, further comprising:

a radio frequency power supply unit for outputting radio frequency power;

a high pass filter provided between the radio frequency power supply unit and the substrate holder for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit; and

a first low pass filter provided between the bias power supply unit and the substrate holder for passing an output of the bias power supply unit therethrough toward the substrate holder and preventing an output of the radio frequency power supply unit from being input to the bias power supply unit.

8. The ion plating device according to any of Claims 1 to 4, wherein

the bias power supply unit comprises a direct current power supply for forming the negative bias and an impulse train power supply for forming the pulse bias, further comprising:

a second low pass filter provided between the direct current power supply and the substrate holder, for passing an output of the direct current power supply therethrough toward the substrate holder and preventing an output of the impulse train power supply from being input to the direct current

power supply; and

a band pass filter provided between the impulse train power supply and the substrate holder, for passing an output of the impulse train power supply therethrough toward the substrate holder and preventing an output of the direct current power supply from being input to the impulse train power supply.

9. The ion plating device according to any of Claims 1 to 4, wherein the bias power supply unit comprises a direct current power supply for forming the negative bias and a pulse power supply for forming the pulse bias, further comprising:

a radio frequency power supply unit for outputting radio frequency power;

a high pass filter provided between the radio frequency power supply unit and the substrate holder for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit; and

a first low pass filter provided between the bias power supply unit and the substrate holder for passing an output of the bias power supply unit therethrough toward the substrate holder and preventing an output of the radio frequency power supply unit from being input to the bias power supply unit.

10. The ion plating device according to any of Claims 1 to 4, wherein the bias power supply unit comprises a direct current power supply for forming the negative bias and an impulse train power supply for forming the pulse bias,

further comprising:

a second low pulse filter provided between the direct current power supply and the substrate holder for passing an output of the direct current power supply therethrough toward the substrate holder and preventing an output of the impulse train power supply from being input to the direct current power supply;

a band pass filter provided between the impulse train power supply and the substrate holder for passing an output of the impulse train power supply therethrough toward the substrate holder and preventing an output of the direct current power supply from being input to the impulse train power supply;

a radio frequency power supply unit for outputting radio frequency power; and

a high pass filter provided between the radio frequency power supply unit and the substrate holder for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit, wherein

the second low pass filter is adapted to further prevent an output of the radio frequency power supply unit from being input to the direct current power supply, and

the band pass filter is adapted to further prevent an output of the radio frequency power supply unit from being input to the impulse train power supply.

11. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit is adapted to output a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz, and output radio frequency power, further comprising:

a function generator for synthesizing a waveform corresponding to the negative bias component of the bias voltage, a waveform corresponding to the pulse bias component of the bias voltage, and a waveform corresponding to radio frequency of the radio frequency power; and

a linear amplifier for amplifying the waveform synthesized by the function generator and supplying an amplified waveform.

12. The ion plating device according to any of Claims 1 to 4, wherein

the bias power supply unit comprises a waveform generator for generating a basic waveform of the bias voltage and a bias power supply for generating the bias voltage having a constant value based on the basic waveform output from the waveform generator, further comprising:

a radio frequency power supply unit for outputting radio frequency power;

a high pass filter provided between the radio frequency power supply unit and the substrate holder for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit; and

a first low pass filter provided between the bias power supply unit and the substrate holder for passing an output of the bias power supply unit therethrough toward the substrate holder and preventing an output of the radio frequency power supply unit from being input to the bias power supply unit, wherein

a preliminary plasma forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa, and the bias voltage in which an absolute value of the pulse bias component is smaller than an absolute value of the negative bias component is output with a cycle set in a range of 1kHz to 1GHz to generate a preliminary plasma and then,

a film forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state in which the material of the film can be vaporized to generate a plasma for film formation and the radio frequency power as well as the bias voltage is output to generate the plasma for film formation, thereby forming the film on the substrate.

13. The ion plating device according to any of Claims 1 to 4, wherein the bias power supply unit comprises a direct current power supply for forming the

negative bias and a pulse power supply for forming the pulse bias, further comprising:

a radio frequency power supply unit for outputting radio frequency power;

a high pass filter provided between the radio frequency power supply unit and the substrate holder for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit; and

a first low pass filter provided between the bias power supply unit and the substrate holder for passing an output of the bias power supply unit therethrough toward the substrate holder and preventing an output of the radio frequency power supply unit from being input to the bias power supply unit, wherein

a preliminary plasma forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa, and the bias voltage in which an absolute value of the pulse bias component is smaller than an absolute value of the negative bias component is output with a cycle set in a range of 1kHz to 1GHz to generate a preliminary plasma and then,

a film forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state in which the material of the film can be vaporized to generate a plasma for film formation and the radio frequency power as well as the bias voltage is output to generate the plasma for film formation, thereby forming the film on the substrate.

14. The ion plating device according to any of Claims 1 to 4, wherein the bias power supply unit comprises a direct current power supply for forming the negative bias and an impulse train power supply for forming the pulse bias, further comprising:

a second low pass filter provided between the direct current power supply and the substrate holder, for passing an output of the direct current power supply therethrough toward the substrate holder and preventing an output of the impulse train power supply from being input to the direct current power supply;

a band pass filter provided between the impulse train power supply and the substrate holder, for passing an output of the impulse train power supply therethrough toward the substrate holder and preventing an output of the direct current power supply from being input to the impulse train power supply;

a radio frequency power supply unit for outputting radio frequency power;

a high pass filter provided between the radio frequency power supply unit and the substrate holder, for passing an output of the radio frequency power supply unit therethrough toward the substrate holder and preventing an output of the bias power supply unit from being input to the radio frequency power supply unit, wherein

the second low pass filter is adapted to further prevent an output of the radio frequency power supply unit from being input to the direct current power supply,

the band pass filter is adapted to further prevent an output of the radio

frequency power supply unit from being input to the impulse train power supply,

a preliminary plasma forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa and the bias voltage in which an absolute value of the pulse bias component is smaller than an absolute value of the negative bias component is output with a cycle set in a range of 1kHz – 1GHz to generate a preliminary plasma and then,

a film forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state in which the material of the film can be vaporized to generate a plasma for film formation and the radio frequency power as well as the bias voltage is output to generate the plasma for film formation, thereby forming the film on the substrate.

15. An ion plating device comprising:

a vacuum chamber adapted to be evacuated;

a substrate holder placed in the vacuum chamber for holding a substrate; and

a power supply unit for supplying power used for changing a material of a film to be formed on the substrate into a plasma and depositing the film from the plasma on the substrate to an inside of the vacuum chamber through the substrate holder, wherein

the power supply unit is adapted to output a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a

pulse output having a positive voltage value for a predetermined time, with a cycle set in a range of 1kHz to 1GHz, and output radio frequency power, further comprising:

a function generator for synthesizing a waveform corresponding to the negative bias component of the bias voltage, a waveform corresponding to the pulse bias component of the bias voltage, and a waveform corresponding to radio frequency of the radio frequency power; and

a linear amplifier for amplifying the waveform synthesized by the function generator and supplying an amplified waveform, wherein

a preliminary plasma forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa, and the bias voltage in which an absolute value of the pulse bias component is smaller than an absolute value of the negative bias component is output with a cycle set in a range of 1kHz to 1GHz to generate a preliminary plasma and then,

a film forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a vacuum state in which the material of the film can be vaporized to generate a plasma for film formation and the radio frequency power as well as the bias voltage is output to generate the plasma for film formation, thereby forming the film on the substrate.

16. The ion plating device of Claim 15, wherein the cycle of the bias voltage applied together with the radio frequency power in formation of the film on the substrate is set between 10kHz and 500kHz.

17. The ion plating device according to any of Claims 1 to 4, wherein a preliminary plasma forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa and the bias voltage in which an absolute value of the pulse bias component is smaller than an absolute value of the negative bias component is output with a cycle set in a range of 1kHz to 1GHz to generate a preliminary plasma and then,

a film forming process is adapted to be carried out in such a manner that the vacuum chamber is evacuated to a state in which the material of the film can be vaporized to generate a plasma for film formation and the bias voltage is output with a cycle set in a range of 1MHz to 1GHz to generate the plasma for film formation, thereby forming the film on the substrate.

18. An ion plating method in which a vacuum chamber in which a substrate holder for holding a substrate and a vaporizing source for holding a material of a film to be formed on the substrate are placed is evacuated to a vacuum state and predetermined power is supplied to an inside of the vacuum chamber through the substrate holder to generate a plasma from which the film is formed on the substrate, comprising the steps of:

evacuating the vacuum chamber to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa and applying a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined output time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, the pulse bias component having an absolute value smaller than an absolute value of the negative bias component, with a

cycle set in a range of 1kHz to 1GHz, to generate a preliminary plasma; and

evacuating the vacuum chamber to a state in which the material of the film can be vaporized to generate a plasma for film formation and applying radio frequency power as well as the bias voltage to generate the plasma for film formation.

19. The ion plating method of Claim 18, wherein the cycle of the bias voltage in the step of generating the plasma for film formation is set between 10kHz and 500kHz.

20. An ion plating method in which a vacuum chamber in which a substrate holder for holding a substrate and a vaporizing source for holding a material of a film to be formed on the substrate are placed is evacuated to a vacuum state and predetermined power is supplied to an inside of the vacuum chamber through the substrate holder to generate a plasma from which the film is formed on the substrate, comprising the steps of:

evacuating the vacuum chamber to a state of 6.7×10^{-3} Pa to 6.7×10^{-1} Pa and applying a bias voltage composed of a negative bias component having a predetermined negative voltage value for a predetermined time and a pulse bias component corresponding to a pulse output having a positive voltage value for a predetermined time, the pulse bias component having an absolute value smaller than an absolute value of the negative bias component, with a cycle set in a range of 1kHz to 1GHz, to generate a preliminary plasma; and

evacuating the vacuum chamber to a state in which the material of the film can be vaporized to generate a plasma for film formation and applying the

bias voltage with a cycle set in a range of 1MHz to 1GHz to generate the plasma for film formation.